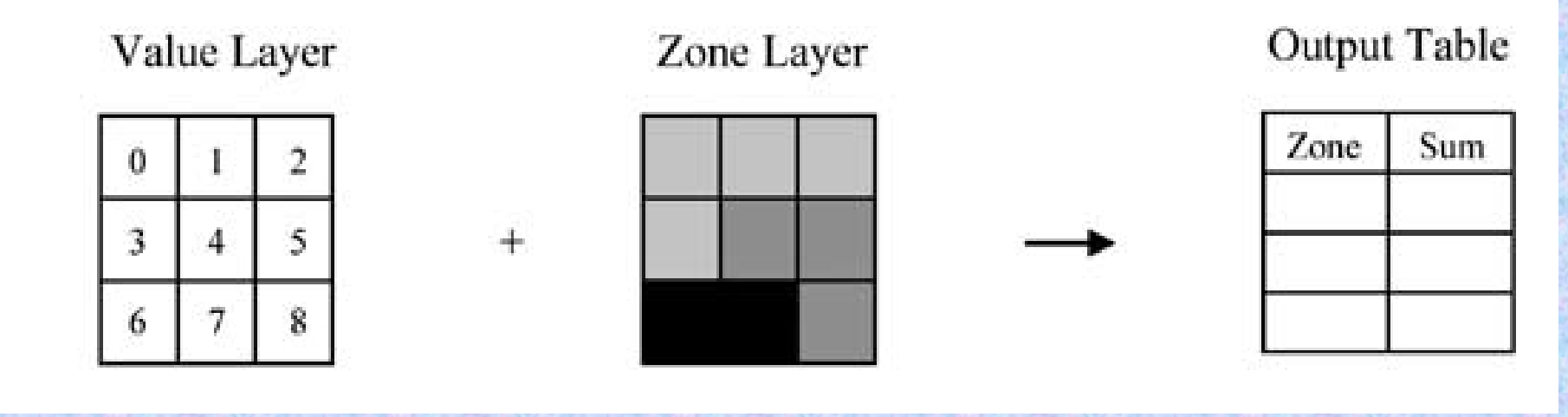
Vector Zonal Operations for Spatiotemporal Analysis

Tingting Xu
Department of Geography
University of Kansas

Conventional Zonal Operations

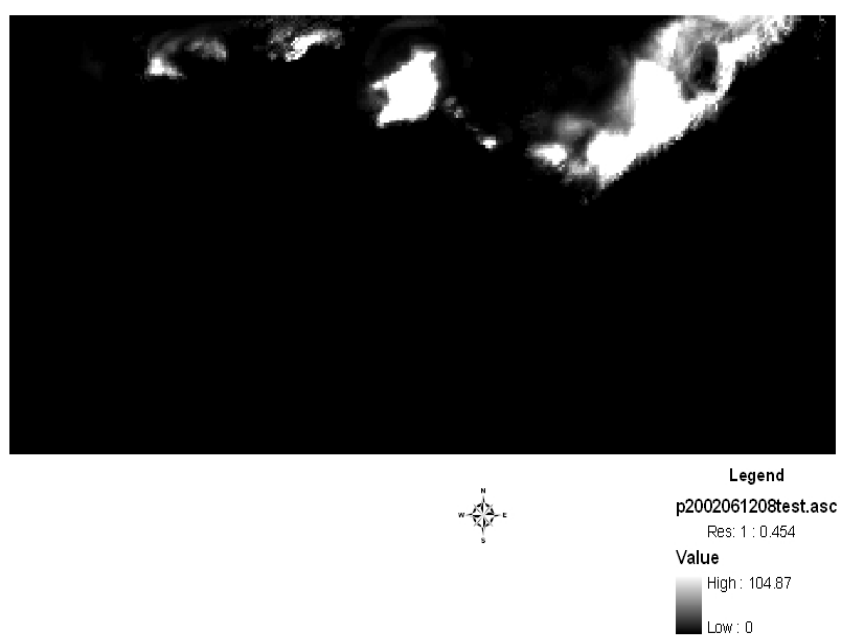
Zonal operations take a zone and value raster layer as inputs and calculate a value for each cell using the cell values in the same zone into which the cell falls.

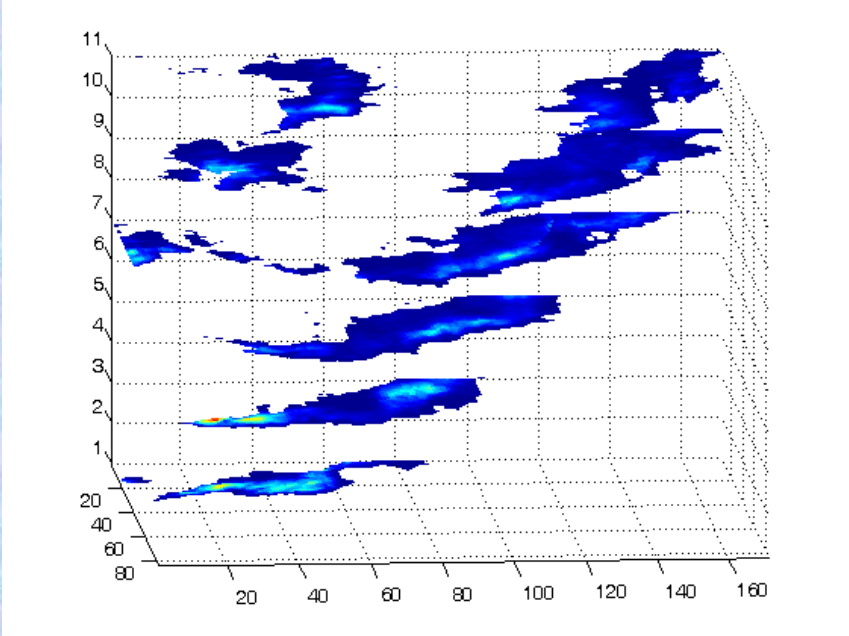
Zones are defined by the cells which have the same value on the zone layer.



Zonal Operations for Spatiotemporal Data

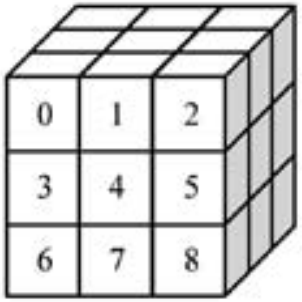
- Very few geographic phenomena and processes are static
- Developments in data collection techniques have produced a large amount of spatiotemporal datasets (NDVI, MODIS…)





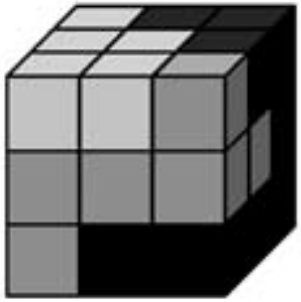
Cubic Zonal Operations

Three-Dimensional Map Algebra Zonal Function



Value Cube

+



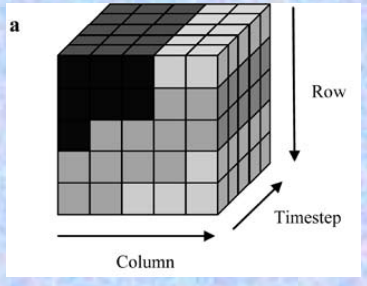
Zone Cube

→

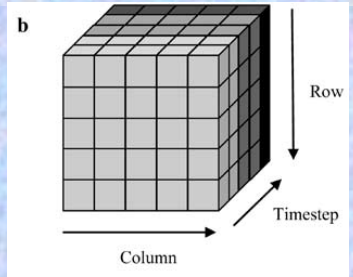
Zone	Sum

Output Table

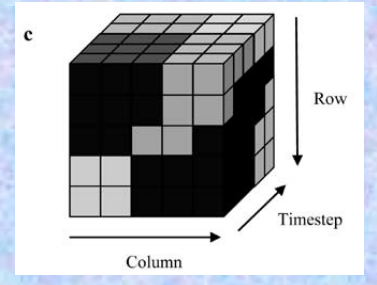
Vary only in Space



Vary only in time



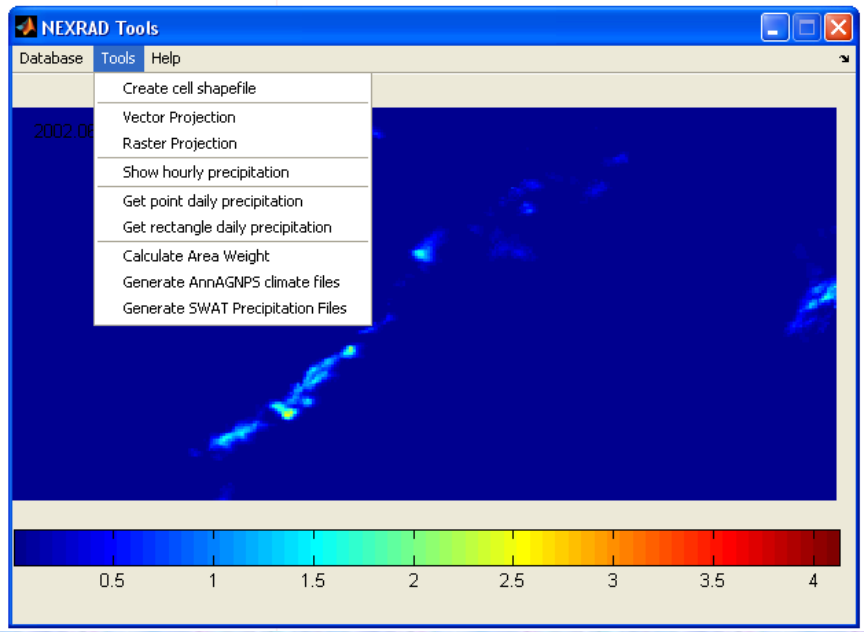
Vary both in space and time



Mennis, J., Viger, R., and Tomlin, D. 2005, "Cubic map algebra functions for spatiotemporal analysis". *Cartography and Geographic Information Science,* 32(1): 17- 32.

NEXRAD Precipitation Database

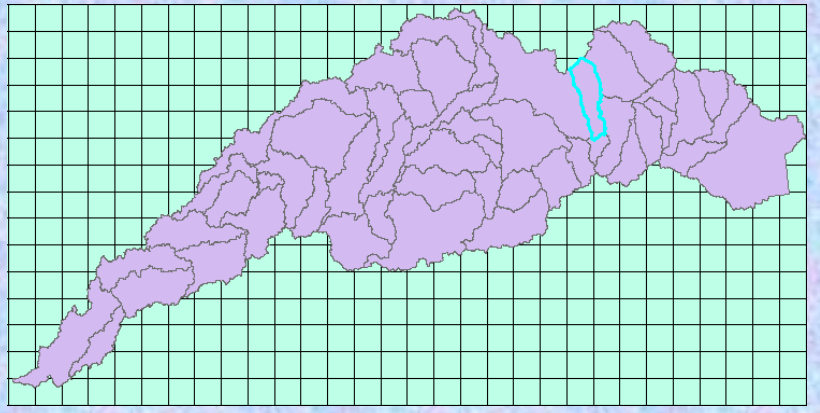
- Radar estimates of precipitation (correct with available rain gauges)
- 4km x 4km spatial resolution
- Hourly temporal resolution
- NEXRAD Tool



DBInfo	1 KB	MATLAB MAT-file	6/4/2008 4:51 PM
ts1995100100	13 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100101	12 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100102	12 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100103	10 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100104	8 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100105	7 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100106	7 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100107	7 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100108	7 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100109	7 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100110	5 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100111	4 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100112	3 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100113	3 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100114	3 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100115	3 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100116	2 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100117	2 KB	MATLAB MAT-file	12/10/2007 12:29 AM
ts1995100118	2 KB	MATLAB MAT-file	12/10/2007 12:29 AM

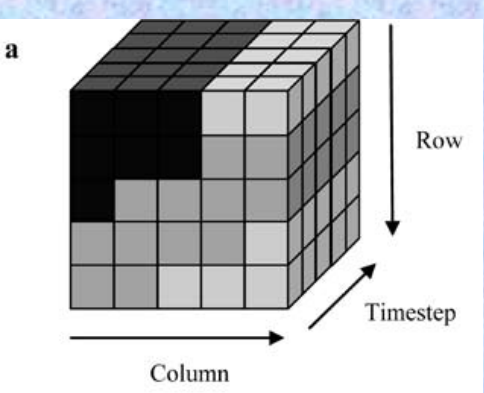
Spatiotemporal Vector Zone

Calculate daily sub-watershed precipitation for non-point source pollution models

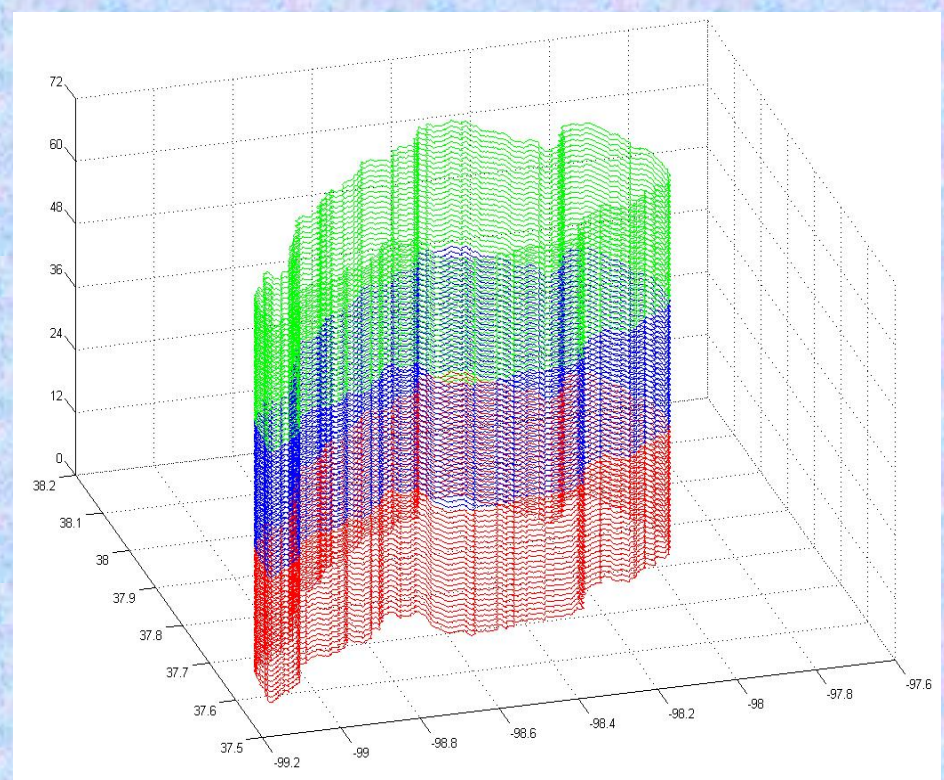


time

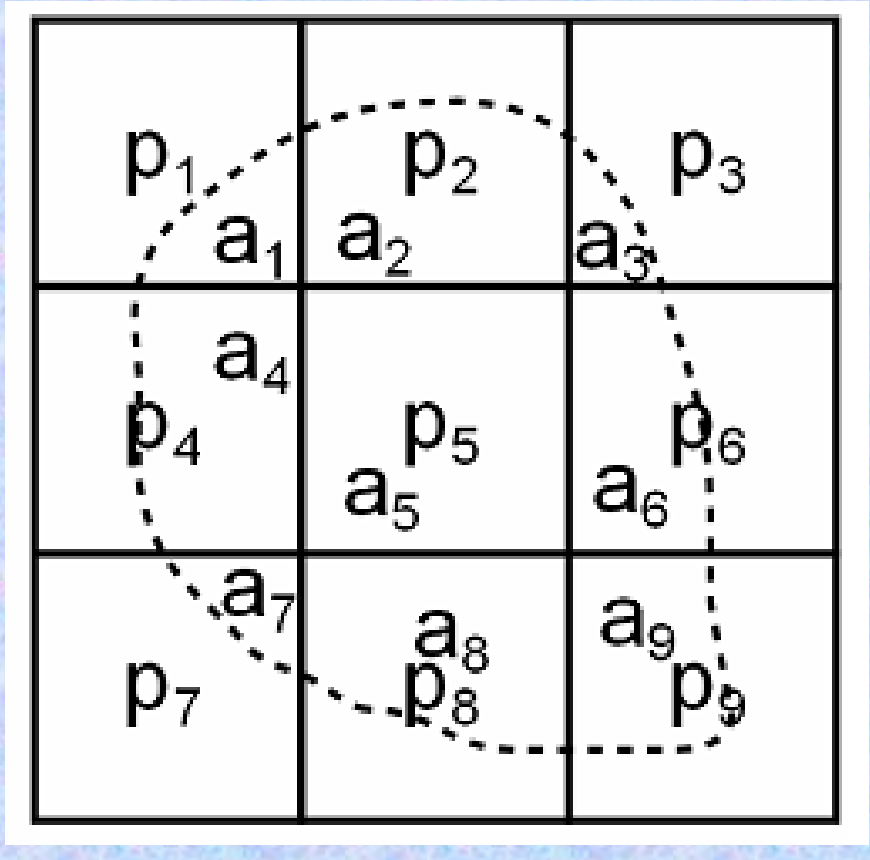
\+ 24 hours (daily)



A	B	C
Date	dailyPrecip	
2002.06.01	0	
2002.06.02	0	
2002.06.03	0	
2002.06.04	16.6699	
2002.06.05	0.50427	



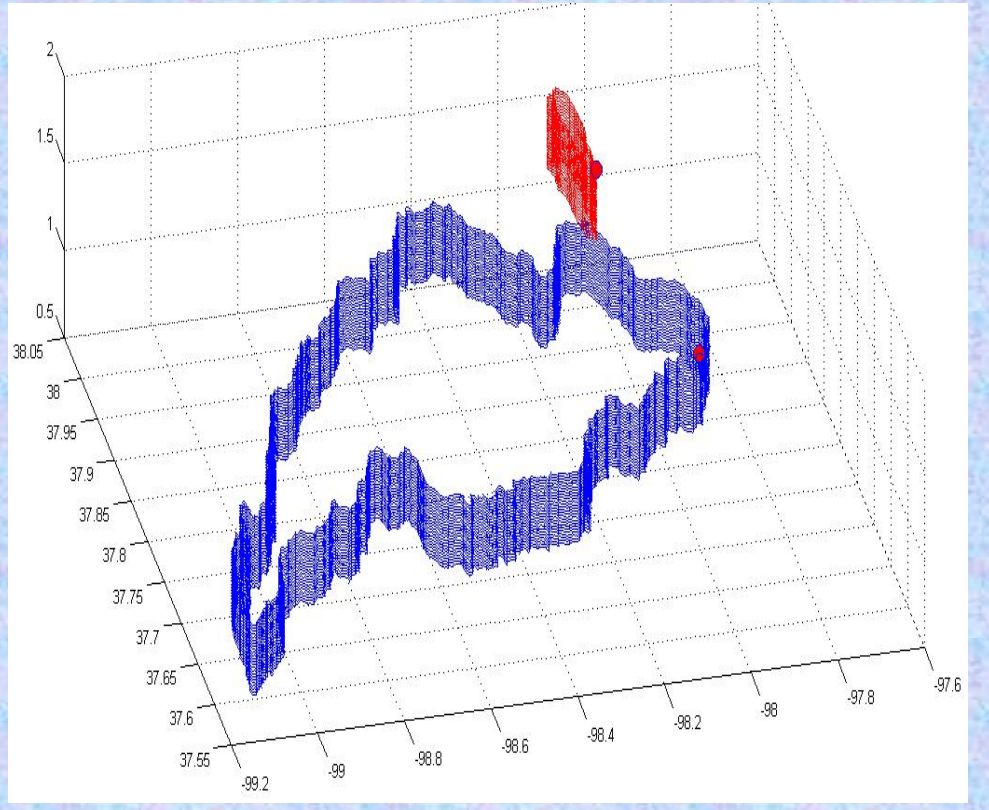
Area Weight Precipitation

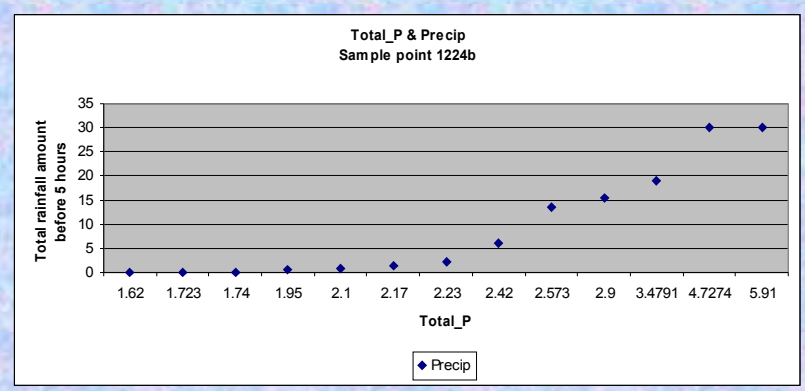


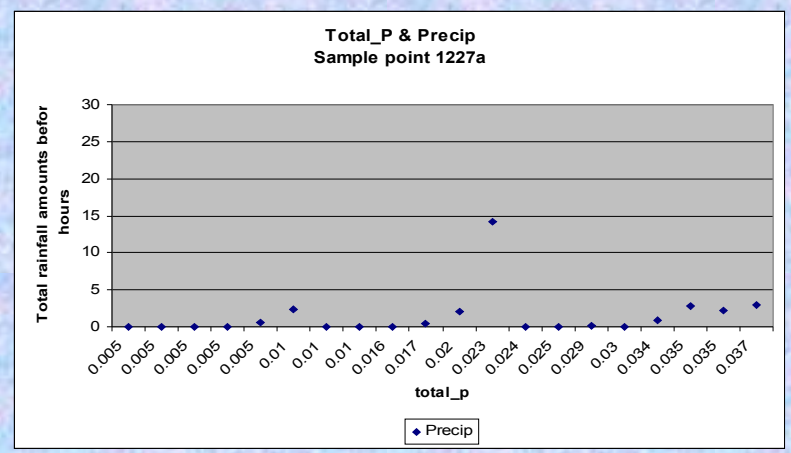
$$p = \frac{\sum_{i=1}^{9} p_i * a_i}{\sum_{i=1}^{9} a_i}$$

Antecedent Precipitation for Water Quality Samples

ID	Date	Total_P(mg/l)
1227a	5/2/99 14:00	0.05
1224b	5/1/99 13:00	0.1







Acknowledgement

- USDA, “Developing NEXRAD-based precipitation datasets for the Cheney Lake watershed for use in water quality models” (PI, Xingong Li)